REMARKS

This is responsive to an Office Communication mailed November 19, 2002, an Office Communication mailed September 27, 2002, and an Interview held between Applicant's representative and the Examiner on January 23, 2003. Applicant wishes to thank the Examiner for the courtesies extended during this telephone interview. Pursuant to the Examiner's suggestions, claims 1 and 40 have been amended to satisfy the concerns raised in the November 19, 2002 Communication, such that Applicant's Response to the September 27, 2002 Election Requirement is now complete.

Notwithstanding the amendments to claims 1 and 40, it is respectfully noted that the embodiment of FIG. 5B in combination with the drive of FIGS. 6A-6B does provide a continuous motion robotics system in which the robotic arms are coaxially arranged relative to one another. In particular, each arm 202 includes a first primary link 206 connected to a closed track 204. The track 204 defines at least one instant center (e.g., 212) about which the links 206, and thus the arms 202 rotate. Thus, the instant center provides a central or common axis about which the robotic arms rotate in a continuous manner, with the instant center defining a first primary joint. Thus, although the robotic arms may be interpedently driven about the closed track 204, they are effectively linked to one another as the instant center, with the closed nature of the track 204 affording movement of the robotic arm 202.

Having thus fully addressed the Election Requirement, it is respectfully presented that the claims are now in a condition for examination on the merits.

CONCLUSION

It is believed that all claims are now in a condition for allowance. Notice to that effect is respectfully requested.

No fees are required under 37 C.F.R. 1.16(b)(c). However, if such fees are required, the Patent Office is hereby authorized to charge Deposit Account No. 500471.

Attached hereto is a marked-up version of the changes made to the specification and/or the claims by the current Amendment. The attached pages are captioned **"VERSION WITH MARKINGS TO SHOW CHANGES MADE"**.

The Examiner is invited to contact the Applicants' Representative at the below-listed telephone number if there are any questions regarding this response.

Respectfully submitted,

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CERTIFICATE UNDER 37 C.F.R. 1.8: The undersigned hereby certifies that this paper or papers, as described herein, are being deposited in the United States Postal Service, as first class mail, in an envelope address to: Commissioner for Patents, Washington, D.C., 20231 on this 27th day of **January, 2003**.

By

Name: **Timothy A. Czaja**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Thomas R. Corrigan — Examiner: Joseph E. Valenza
Serial No.: 09/905,095 — Group Art Unit: 3651
Filed: July 13, 2001 — Docket No.: 56226US002 (M120.134.101)
Date Due: **January 27, 2003** (w/ extension)
Title: CONTINUOUS MOTION ROBOTIC MANIPULATOR

SUPPLEMENTAL RESPONSE TO ELECTION REQUIREMENT

Commissioner for Patents
Washington, D.C. 20231

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Dear Sir/Madam:

This is responsive to the Communication mailed November 19, 2002. Please amend the above-identified patent application as follows:

IN THE CLAIMS

Please amend claims 1 and 40 as follows:

1.(Amended) A continuous motion robotic device for processing objects, the device comprising:

a first robotic arm;

a second robotic arm;

a third robotic arm;

wherein the robotic arms are each configured to rotate a full 360° ~~continuously~~ and each include an end effector for performing work on an object, and further wherein the robotic arms are ~~coaxially~~ arranged about a common axis relative to one another; and

a drive system commonly controlling the robotic arms, the drive system ~~defining~~ propelling the robotic arms about a central axis ~~about which the robotic arms rotate~~.

2. The device of claim 1, wherein the robotic arms are identical.

3. The device of claim 1, wherein each of the robotic arms includes a first, second and third primary link.

4. The device of claim 3, wherein the drive system includes a first input driving each of the first primary links, a second input commonly driving each of the second primary links, and a third input commonly driving each of the third primary links.

5. The device of claim of claim 4, wherein at least one of the first, second and third inputs includes a servo-motor.

6. The device of claim 4, wherein at least one of the first, second and third inputs includes a cam.

7. The device of claim 6, wherein the cam is a barrel cam.

8. The device of claim 1, wherein each of the robotic arms includes a first primary link, a second primary link, a first primary joint connecting the first primary link to the drive system, and a second primary joint connecting the first and second primary links.

9. The device of claim 8, wherein the second primary joints are rotary joints.

10. The device of claim 8, wherein the second primary joints are sliding joints.

11. The device of claim 8, wherein the first primary joints are coupled to one another and the second primary joints are coupled to one another by the drive system such that upon activation of the drive system, the robotic arms are directed through substantially identical paths and the end effectors are positioned at a substantially identical radial distance relative to the center point at any point in time.

12. The device of claim 11, wherein the robotic arms each further include a third primary link connected to the second primary link by a third primary joint, each of the third primary joints being coupled to one another by the drive system.

13. The device of claim 12, wherein the drive system includes:

a first input including a first central shaft and a first hub, the first primary links being rigidly affixed to the first hub such that the first hub defines the first primary joints and rotation of the first hub commonly rotates the first primary links;

a second input including a second central shaft and a second hub, the second primary joints being commonly coupled by the second hub such that rotation of the second hub commonly rotates the second primary links about the second primary joints, respectively; and

a third input including a third central shaft and a third hub, the third primary joints being commonly coupled by the third hub such that rotation of the third hub commonly rotates the third primary links about the third primary joints, respectively.

14. The device of claim 13, wherein the third input further includes a plurality of secondary connectors, respective ones of which couple respective ones of the third primary joints and the third hub, the secondary connectors being commonly driven by the third hub.

15. The device of claim 14, wherein at least one of the secondary connectors is a pulley belt.

16. The device of claim 13, further including a secondary link connecting the second hub to the second primary link.

17. The device of claim 13, further comprising a secondary link connecting the third hub to the third primary link.

18. The device of claim 8, wherein the first primary joints and the second primary joints move independent of one another such that upon activation of the drive system, the robotic arms are directed through substantially identical paths and the end effectors are positioned at a different radial distance relative to the centerpoint during at least one point in time.

19. The device of claim 18, wherein the drive system includes:

a closed loop track having an instant center at any point in time that defines the center point; and

a plurality of first carts separately and moveably coupled to the track, respective ones of which define respective ones of the first primary links, the instant center point of the track defining the first primary joint.

20. The device of claim 19, wherein each of the robotic arms further includes a third primary link connected to the second primary link by a third primary joint.

21. The device of claim 19, wherein the drive system further includes a plurality of second joint servo-motors, respective ones of which are connected to and drive respective ones of the second primary joints.

22. The device of claim 21, wherein each of the robotic arms further includes a third primary link connected to the second primary link by a third primary joint, and further wherein the drive system further includes a plurality of third joint servo-motors, respective ones of which are connected to and drive respective ones of the third primary joints.

23. The device of claim 19, wherein the drive system further includes:

a plurality of second carts separately and moveably mounted to the track, respective ones of which are connected to respective ones of the second primary joints.

24. The device of claim 23, wherein the drive system further includes:

a plurality of coupler links connecting respective ones of the plurality of second carts to respective ones of the second primary joints.

25. The device of claim 23, wherein each of the robotic arms each include a third primary link connected to the second primary link by a third primary joint, the drive system further comprising:

a plurality of third carts separately and moveably coupled to the track, respective ones of which are connected to respective ones of the third primary joints.

26. The device of claim 25, wherein the drive system further includes:

a plurality of coupler links connecting respective ones of the plurality of third carts to respective ones of the third primary joints.

27. The device of claim 19, wherein the track includes an inner guide member and an outer guide member, each of the carts being moveably mounted between the guide members.

28. The device of claim 27, wherein the drive system further comprises:

a stationary gear coaxially disposed below the track, the stationary gear having a toothed surface extending adjacent the inner guide member; and

a plurality of drive gears, respective ones of which are secured to respective ones of the plurality of carts, the drive gears being configured to interface with the stationary gear upon final assembly;

wherein rotation of the drive gears causes the respective cart to articulate about the track via the stationary gear.

29. The device of claim 27, wherein the drive system further comprises:

a magnet system positioned below the track; and

a plurality of linear motors, respective ones of which are secured to respective ones of the carts, the linear motors being configured to interact with a magnetic field generated by the magnet system upon final assembly;

wherein energization of the linear motors causes the respective cart to articulate about the track.

30. The device of claim 27, wherein the drive system further comprises:

four barrel cams arranged below the track, each of the barrel cams forming at least one cam track; and

a plurality of followers, respective ones of which extend from respective ones of the carts, the followers being sized to be slidably engaged within the cam tracks;

wherein rotation of the barrel cams causes the carts to articulate about the track via interaction between the respective followers and the cam tracks.

31. The device of claim 18, wherein the drive system includes:

a plurality of first rotatable cylinders, respective ones of which define respective ones of the first primary joints; and

a plurality of second rotatable cylinders, respective ones of which are connected to respective ones of the second primary joints;

wherein the cylinders are coaxially stacked and are separately rotatable.

32. The device of claim 31, wherein each of the robotic arms further includes a third primary link connected to the second primary link by a third primary joint, the drive system further including:

a plurality of third rotatable cylinders, respective ones of which are connected to respective ones of the third primary joints.

33. The device of claim 31, wherein each of the first and second cylinders are rings having an inner surface forming cam paths.

34. The device of claim 1, wherein each of the three robotic arms are co-planar.

35. The device of claim 1, wherein each of the robotic arms extend from a hub of the drive system in different planes.

36. A continuous motion robotic device for processing objects, the device comprising:
a plurality of robotic arms, each including:
a first primary link,
a first primary joint about which the first primary link rotates,
a second primary link,
a second primary joint connecting the second primary link to the first primary link,
an end effector for performing work on an object, a spatial position of the end effectors being determined by the respective first and second primary links;
wherein each of the first primary links are continuously rotatable about a common axis;
wherein the first primary joints are coupled to one another and the second primary joints are coupled to one another; and
a drive system for controlling the robotic arms, the drive system including a first input commonly driving the first primary joints and a second input commonly driving the second primary joints.

37. The device of claim 36, wherein the second primary joints are rotary joints.

38. The device of claim 36, wherein the second primary joints are sliding joints.

39. The device of claim 36, wherein the first input includes a rotatable hub defining the first primary links and a center point of the hub defining the first primary joints.

40.(Amended) A method of processing objects within a workspace, the method comprising:

providing ~~continuous motion~~ a robotic system including three ~~coaxially~~ commonly arranged robotic arms each including an end effector, the robotic arms extending radially from a hub defined by a drive system, wherein the drive system commonly drives the three robotic arms;

determining a first desired path for the end effector based upon parameters of a first workspace;

configuring the drive system to articulate the end effectors through the first desired path;

positioning the robotic system within the first work space; and

operating the drive system such that the end effectors pass through the first desired path to process objects within the first workspace.

41. The method of claim 40, wherein the first desired path includes each of the end effectors being positioned at substantially identical radial distances relative to a center of the hub at any point in time.

42. The method of claim 40, wherein the first desired path includes at least two of the end effectors being positioned at different radial distances relative to a center of the hub during at least one point in time.

43. The method of claim 40, wherein each robotic arm has three primary links and the drive system includes three inputs controlling movement of each of the three primary links, respectively, and further wherein configuring the drive system includes configuring each of the inputs to produce the first desired path.

44. The method of claim 40, further comprising:

determining a second desired path for the end effectors based upon parameters of a second workspace;

reconfiguring the drive system to articulate the end effectuators through the second desired path;

positioning the robotic system within the second work space; and

operating the drive system such that the end effectors pass through the second desired path to process objects within the second workspace.

45. The method of claim 44, wherein each of the robotic arms includes three primary links and the drive system includes three inputs controlling each of the three primary links, respectively, and further wherein reconfiguring the drive system includes reconfiguring the three inputs.

46. The method of claim 45, wherein the three inputs each include a cam, and further wherein reconfiguring the three inputs includes changing at least one of the cams.

47. The method of claim 45, wherein the three inputs each include a servo-motor, and further wherein reconfiguring the three inputs includes altering the output of at least one of the servo-motors.

48. The method of claim 40, further comprising:

determining a second desired path for the end effectors based upon revised parameters of the first workspace;

reconfiguring the drive system to articulate the end effectuators through the second desired path; and

operating the drive system such that the end effectors pass through the second desired path to process objects within the first workspace.

49. The method of claim 48, wherein the revised parameters are based on information provided by a feedback sensor.

50. A method of processing objects within a workspace, the method comprising:

providing a continuous motion robotic system including a plurality of robotic arms each including a first primary link, a first primary joint about which the first primary link rotates, a second primary link, a second primary joint connecting the first and second primary links, an end effector positioned by the first and second primary links, and a drive system, wherein the first primary links are coupled to one another and the second primary links are coupled to one another;

determining a first desired path for the end effector based upon parameters of a first workspace;

configuring the drive system to articulate the end effectors through the first desired path;

positioning the robotic system within the first work space; and

operating the drive system such that the end effectors pass through the first desired path to process objects within the first workspace.